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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO A FASTENING DEVICE FOR ASSEMBLING METAL SHEETS AND THE LIKE

(71) We, SIMMONDS S.A., a Body Corporate organized under the laws of France, of 3, rue S. de Rothschild, 92 — Suresnes, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a fastening device for assembling metal sheets, plates or the like.

A certain number of bolting devices have already been proposed for assembling metal sheets for making, for instance, airframes. Such bolting devices must therefore be designed with the greatest care.

Indeed, in a metal-sheet assembly such bolting devices must ensure an almost ideal transmission of the shear stresses through the fastenings. Moreover, the said assemblies must have high fatigue strength and the bolting devices used in such assemblies must be inexpensive and readily and rapidly mountable while at the same time imparting to the assembly the required sturdiness, which is fundamental in the aircraft industry.

Thus, the fatigue strength of such assemblies is nowadays improved by ensuring in the fastening region a double local compression of the assembled metal sheets, i.e.:

—a substantially vertical compression of the metal sheets on one another, such as usually ensured by a bolt with nut, and

— a radial compression of the metal sheets in the region of the fastening holes in which the screws are inserted, thus leading to the screw shanks being made integral with the metal sheet by being held in the latter with a tight fit.

In order that this double-compression function should be fulfilled, use was made, up to the present, of screws comprising a smooth taper portion or shank, the end of which was provided with a thread for a nut. Such fastening devices are known under the Registered Trade Mark "Taper Lok".

There are, however, a number of drawbacks to such fastening devices.

Indeed, before mounting the latter, it is first necessary to firmly attached to one another the metal sheets to be assembled, and then to bore the metal sheets by means of a slightly tapered reamer, the taper of which is the same as that of the screw shank. The said screw is forced into the bore until the screw head comes to bear upon the upper metal sheet so as to ensure the vertical and radial compression of the assembled sheets before completing the assembling by screwing a nut on the screw end projecting from the lower sheet.

However appealing this solution may seem, such an assembling method is nevertheless highly expensive, for it must be carried out with high accuracy. Indeed, it has been observed that if the bore is not perfect the method is ineffective. Thus, the cost of and difficulties in the use of such a fastening device finally render it uninteresting when used on a large scale.

The present invention accordingly seeks to avoid the aforesaid drawbacks.

According to the present invention there is provided a fastening device for assembling metal plates, sheets, or the like, comprising a screw, a sleeve and a nut, said screw having a tapered shank, an enlarged screw head on the larger end of said shank and a threaded portion on the smaller end of said shank to receive said nut, and said sleeve having a cylindrical outer surface and a tapered inner surface, the taper of which corresponds to that of said shank.

Said sleeve defines a cylindrical outer bearing surface, and it is readily understood that it is sufficient to provide the metal sheets which are to be fastened with the fastening device according to the invention with a corresponding cylindrical bore instead of a tapered bore.

Preferably said sleeve is provided at its end corresponding to the larger end of said tapered inner surface with an external flange.

Said flange may be deformable upon screwing said nut on the smaller end of said shank.

Such a deformable flange placed between the upper sheet and the screw head therefore permits, during the screwing of the nut, of first ensuring a vertical compression of the sheets before achieving a radial compression of the latter in the region of the fastening hole, the said radial compression occurring from the moment when the screw shank, being inserted into the sleeve by screwing the nut, comes into contact with the tapered inner surface of the said sleeve.

Said sleeve may be made of a relatively deformable metal to permit the outer diameter of the sleeve to expand as said shank is forced into said sleeve.

Said screw may be a counter-sunk head screw or a non-counter-sunk head screw, according to the requirements of the assembly to be obtained.

Said nut advantageously is a safety nut of the type provided with a deep internal counter-bore adjacent to that surface which is for bearing upon the metal sheets and such as described in Patent Specification No. 1,331,460.

In order to ensure good transmission of the shear stresses through the screw, it is indeed necessary that only the smooth portion of the screw or of the sleeve should be in contact with the metal sheets. The screw thread must therefore be located completely outside the thickness of the assembled sheets. Thus, in order that a correct clamping by the nut should be ensured, a deep-counter-bore nut such as described in the aforesaid patent specification is desirable.

In order that the invention may be clearly understood and readily carried into effect some preferred embodiments thereof will now be described, by way of exaample only, with reference to the accompanying drawings, wherein:—

Figures 1 and 1*a* are axial sectional views of a fastening device for assembling a stack of metal sheets according to the prior art, the device of Figure 1 including a non-counter-sunk head screw and the device of Figure 1*a* comprising a counter-sunk head screw;

Figures 2 and 2*a* are axial sectional views of fastening devices according to the invention for assembling a stack of metal sheets, the device of Figure 2 including a non-counter-sunk head screw and the device of Figure 2*a* comprising a counter-sunk head screw; and

Figures 3, 3*a*, 4, 4*a* and 5, 5*a* are also axial sectional views of fastening devices according to the invention, but including a sleeve provided with a deformable flange or shoulder, and illustrate three consecutive steps of the mounting of the said devices in a stack of metal sheets; Figures 5, 5*a* show the devices in their respective final clamping positions, and Figures 3 to 5 show a device with a non-counter-sunk head screw whereas the corresponding Figures 3*a* to 5*a* show a device with a counter-sunk head screw.

Referring to the drawings, Figures 1 and 1*a* show a fastening or bolting device according to the prior art. As seen in these Figures, such a device is adapted to clamp a stack of metal sheets 1, 2 and 3 and comprises a screw 4, the smooth and tapered shank 5 of which is placed in a corresponding taper bore 6 provided in the stack of sheets 1, 2 and 3. The shank 5 of the screw 4 has a cylindrical threaded end 7 for a nut 8. Lastly, the head 9 of the screw 4 may be a non-couonter-sunk head (Figure 1) or a counter-sunk head (Figure 1*a*), according to the requirements of the assembly to be obtained, and a washer 15 may be interposed between the nut 8 and the lower sheet 3.

As previously stated, before mounting the screw just described it is necessary to provide the sheets 1, 2 and 3 with an accurately tapered bore, the taper of which corresponds to that of the shank 5 of screw 4. Thereafter, the screw 4 is forced into the said bore by means of a tool, thus causing a radial compression of the sheets.

In the forms of fastening device shown in Figures 2 and 2*a*, a sleeve 10 made of a relatively deformable metal is fitted onto the shank 5 of the screw 4. The sleeve 10 has a cylindrical outer surface 11 bearing upon the sheets, and a tapered inner surface 12 bearing upon the tapered shank 5 of the screw 4.

Owing to the sleeve 10 of the invention, it is therefore sufficient to provide the sheets 1, 2 and 3 with a cylindrical bore, which can be done much more easily and with less need for accuracy than for the tapered bore which is necessary with the prior-art fastening devices.

As seen in Figures 2 and 2*a*, the sleeve 10 is provided at its top with a flange or shoulder 3 interposed between the screw head 9 and the upper sheet 1.

The mounting of the devices just described may be carried out in two different manners:

(a) After positioning the sleeve 10 and screw 4 in the cylindrical bore provided in the sheets, the nut 8 is screwed onto the end 7 of the screw 4. As the nut 8 is being screwed, a vertical and radial compression of the sheets occurs progressively and simultaneously. Otherwise stated, the simultaneous vertical and radial compression occurs only as a result of the screwing of the nut 8 onto the threaded end 7 of the screw 4.

(b) The devices may also be mounted by first "hammering" the screw 4 home into

the sleeve 10, thus resulting only in a radial compression of the sheets. After this "hammering" operation the nut 8 is screwed onto the end 7 of the screw 4 as already described, thus leading to a vertical compression of the sheets while at the same time preserving the radial compression ensured by the previously performed "hammering" operation.

In the form shown in Figures 3 to 5, sleeve 10 of relatively deformable metal may have a flange or shoulder in the form of a deformable portion 14 which, when the nut 8 is screwed, serves to compress the sheets vertically before compressing them radially.

More specifically and as appears from Figures 3 and 3*a*, when the screwing of the nut 8 is started, the screw head 9 bears upon the deformable flange or shoulder 14 of the sleeve 10, but a play 16 is still left between the two tapered surfaces of the shank 5 of the screw 4 and of the sleeve 10 respectively.

When the nut 8 is screwed further, as is better seen in Figures 4 and 4*a*, the screw head 9 presses upon the deformable shoulder 14 and the latter compresses the sheets 1, 2 and 3 vertically. When the shank 5 of the screw is driven to a certain extent into the taper bore of the sleeve 10 and, therefore, when the shoulder 14 is pressed to a certain extent between the screw head 9 and the upper sheet 1, the tapered surfaces of the sleeve 10 and of the shank 5 of the screw come into engagement as shown at 17 in Figures 4 and 4*a*.

When this contact takes place, the deformable shoulder 14 is further pressed as the nut 8 is being screwed. Otherwise stated, the sheets 1, 2 and 3 are still compressed vertically, but when the tapered surfaces of the sleeve and the screw shank are in mutual contact the said surfaces co-operate from that moment to cause a radial expansion of the sleeve, i.e. a radial compression of the sheets simultaneously with the vertical and progressive compression of the latter.

This vertical and radial compression which results from the insertion of the screw shank into the sleeve and thus ensures a tight fit between the sleeve and the sheets, continues until the deformable shoulder 14 is completely pressed against the upper sheet 1 by the screw head 9; this completely pressed state of the shoulder 14 corresponds to the final clamped position of the fastening devices, the said position being clearly shown in Figures 5 and 5*a*.

With the fastening devices shown in Figures 3 to 5 and 3*a* to 5*a*, a radial expansion of the sleeve 10 on the sheets is therefore achieved, the said sheets being previously pressed on one another owing to the deformable shoulder 14. Moreover, it is only the nut 8 that successively performs the vertical compression of the sheets and then the radial compression of the latter while at the same time ensuring the continuation of the vertical compression until the fastening is completed.

The nut 8 advantageously is a safety nut provided with a deep counter-bore such as described in Patent Specification No. 1,331,460.

Of course, the invention is by no means limited to the forms of embodiment described and illustrated, which have been given by way of example only. Thus, the shoulder of the sleeve may have any suitable configuration according to the requirements of the assembly to be obtained.

WHAT WE CLAIM IS:—

1. A fastening device for assembling metal plates, sheets or the like, comprising a screw, a sleeve and a nut, said screw having a tapered shank, an enlarged screw head on the larger end of said shank and a threaded portion on the smaller end of said shank to receive said nut, and said sleeve having a cylindrical outer surface and a tapered inner surface, the taper of which corresponds to that of said shank.

2. A fastening device according to claim 1, in which said sleeve is provided at its end corresponding to the larger end of said tapered inner surface with an external flange.

3. A fastening device according to claim 2, in which said flange is deformable upon screwing said nut on the smaller end of said shank.

4. A fastening device according to any one of claims 1 to 3, in which said sleeve is made of a relatively deformable metal to permit the outer diameter of said sleeve to expand as said shank is forced into said sleeve.

5. A fastening device according to any one of claims 1 to 4, in which said screw is counter-sunk head screw.

6. A fastening device according to any one of claims 1 to 4, in which said screw is a non-counter-sunk head screw.

7. A fastening device according to any one of the preceding claims, in which said nut comprises a deep internal counter-bore adjacent to that surface which is for bearing upon said metal sheets.

8. A fastening device constructed and arranged substantially as herein described and as illustrated in Figure 2, in Figure 2*a*, in Figures 3, 4 and 5 or in Figures 3*a*, 4*a* and 5*a* of the accompanying drawings.

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1341459 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig: 1.

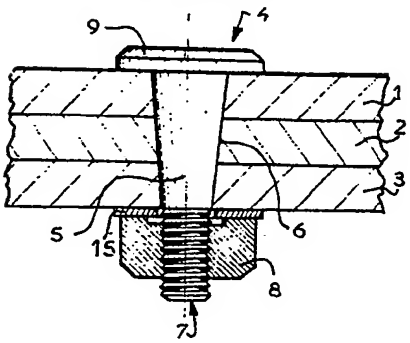

Fig: 1a.

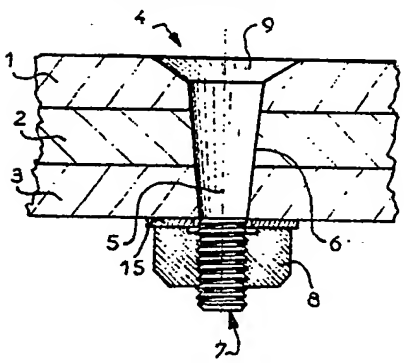

Fig: 2.

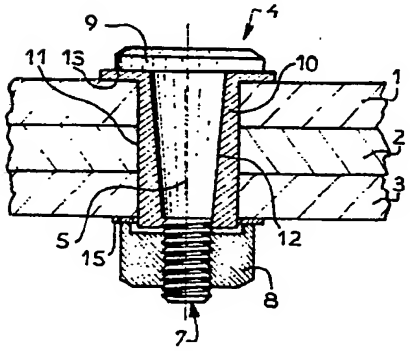

Fig: 2a.

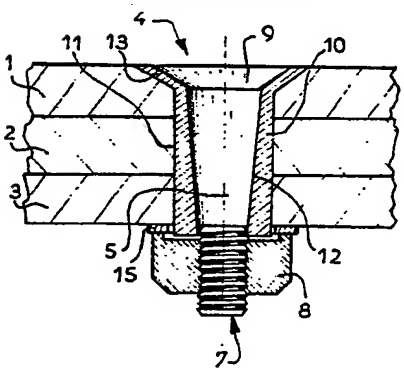

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Fig. 3.

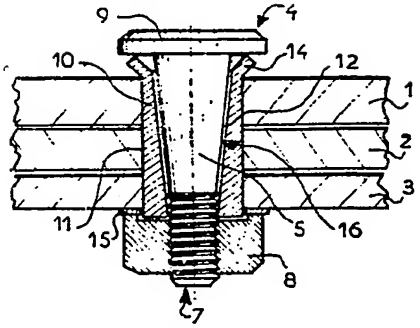

Fig. 3a.

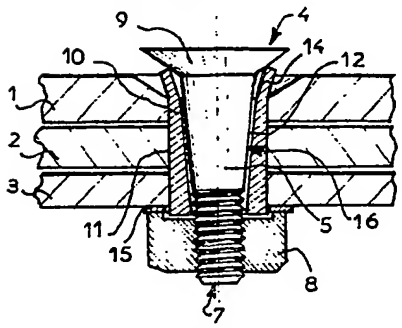

Fig. 4.

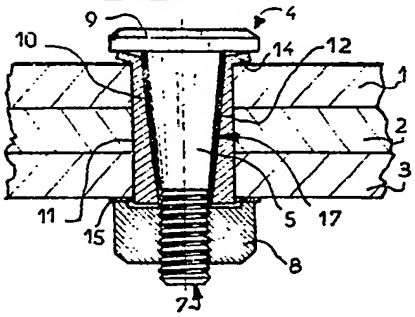

Fig. 4a.

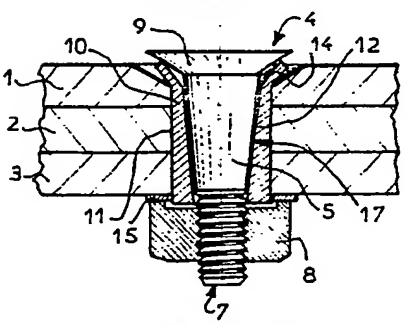

Fig. 5.

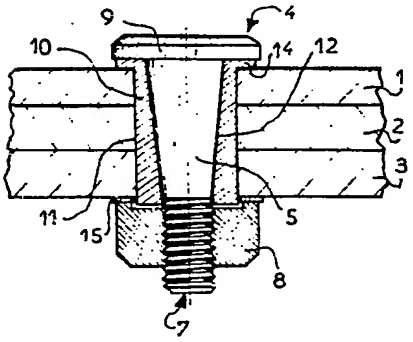

Fig. 5a.